Name of the subject: *Modelling of plastic working processes*			
Course: *Metalurgy*			Code of subject: ***MSTII.GD.2.6***
Type of subject: **specialization**	Level of study: **II level**	Form of study: **intramural studies**	Year: **II** Semester: **III**
Course type: **Lecture, Lab., Seminar, Project**	Number of hours/week: **2, 0, 2, 0, 0**		Number of points: **4 ECTS**

GUIDE OF SUBJECT

I CARD OF SUBJECT

The aim of classes:

C1. The knowledge of basic tests that allow to determine the plasticity of the investigated alloy.
C1. The theoretical knowledge of the influence of the cooling, deformation and cooling conditions on steel properties and microstructure.
C3. The knowledge of tools for physical simulations of forming processes.
C4. The knowledge of tools for numerical simulations of forming processes.
C5. Usage of tools for numerical simulations of forming processes.

PREREQUISITES FOR KNOWLEDGE, SKILLS AND OTHER COMPETENCE

1. Basic knowledge of plastic processing and metal science.
2. Skill in performing mathematical operations to solve given tasks.
3. Ability to use a CAD software.
4. Ability to work independently and in groups.
5. Ability to use laboratory equipment (optical microscope, hardness tester).

EFFECTS OF LEARNING

EL 1 – The student has theoretical knowledge about basic tests to determine the plasticity of the investigated alloy.

EL 1 - The student knows the trends and developments in the modeling of forming processes.

EL 3-Student is able to analyze the results and draw conclusions.

EL 4-Students know the physical tools to simulate forming processes.

EL 5-The student has the ability to make use computer programs as tools for numerical modeling of forming processes.

COURSE CONTENT

Course type – Lecture

L 1, 2 - Basic terms and definitions associated with the modeling of forming processes	**4 h**
L 3, 4 - Overview of the equipment used for physical simulation of forming processes.	**4 h**
L 5 - Basic tests for determining the plasticity of the investigated alloy	**2 h**
L 6 - Basic terms and definitions related to the processing of thermo-plastic.	**2 h**
L 7, 8 - Transformations in steels during continuous cooling after deformation. DTTT-diagrams.	**4 h**
L 9 - The influence of the deformation on the properties of the alloys.	**2 h**
L 10 - Effect of thermomechanical rolling on the properties of alloys	**2 h**
L 11 - Modeling of multstep deformation processes	**2 h**
L 12, 13 - Overview of software for numerical modeling of forming processes.	**4 h**
L 14, 15 - Effect of the rheological properties of the results obtained by computer simulation	**4h**

COURSE CONTENT

Course type – Labolatory

Lab 1 - Determination of alloys strength. Static tensile test, cold heading test.	2h
Lab 2 - Determination of rheological properties of metal alloys.	2h
Lab 3, 4 – Execution physical simulation of thermo - plastic processes.	4h
Lab 5, 6 - Determination of physical properties of the samples after thermo-mechanical simulations	4h
Lab 7 – Design DTTT diagrams based on the results of the physical thermo – plastic processes simulation.	2h
Lab 8, 9 - Determine the impact thermomechanical rolling on the properties of the steel.	4h
Lab 10, 11 - Modeling of multi-stage deformation.	4h
Lab 12, 13 - Modeling of deformation processes using computer programs.	4h
Lab 14, 15 - Effect of the rheological properties of the results obtained by computer simulation	4h

TEACHING TOOLS

1 - Lecture on the use of multimedia presentations
2 - Dilatometer DIL 805A / D
3 - Optical microscope Neophot 2
4 - Vickers hardness tester
5 - Metallurgical simulator Gleeble 3800
6 - Computer lab with software for numerical simulation of forming processes
7 - Laboratory strength tests

METHODS OF EVALUATION (F – FORMING, P - SUMMARY)

F1. – Assessment of the ability to apply the knowledge gained during lectures
F2. – Assessment of preparation laboratory
F3. – Assessment of the ability to apply the knowledge gained during the exercises
F4. – Evaluation reports on the implementation of the programm exercises
F5. – Evaluation of activities in the during exercises
P1. – Assessment of mastery of the material that is the subject of teaching practice - credit with a grade
P2. – Assess the ability of solving the questions posed and the presentation of the results - credit assessment
P3. – Assessment of mastery learning material that is the subject of the lecture - credit

with a grade

STUDENT WORKLOAD

Form of activity	**Average number of hours to realize the activity**
Contact hours with the teacher	**30L 30Lab 60h**
Getting acquainted with the literature	**30**
Preparing for laboratory	**10 h**
Preparing to pass the course	**20 h**
Sum	**∑ 105**
The total points ECTS of course	**4 ECTS**

LITERATURE

1. J.Rychert: Innowacyjne metody przeróbki plastycznej metali, Wydawnictwo AGH, Kraków 2010
2. E. Hadasik: Metodyka wyznaczania charakterystyk plastyczności w próbie skręcania na gorąco, Zeszyty Naukowe Politechniki Śląskiej, Gliwice 2002;.
3. H. Dyja A. Gałkin, M. Knapiński: Reologia metali odkształcanych plastycznie; Wydawnictwo Politechniki Częstochowskiej, Częstochowa 2010
4. Ryś: Metaloznawstwo wybrane zagadnienia pod redakcją Jerzego Pacyny Uczelniane Wydawnictwo Naukowo – Dydaktyczne Kraków 2005
5. Danchenko V., Dyja H., Lesik L., i inni : Technologia i modelowanie procesów walcowania w wykrojach, Wyd. P.Cz. Seria: Metalurgia Nr 28, Częstochowa 2002

LECTURER (NAME, SURNAME, E-MAIL)

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